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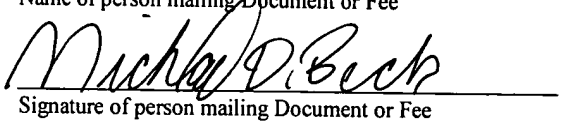
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CHAIR WITH SYNCHRONOUSLY MOVING SEAT AND SEAT BACK

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CHAIR WITH SYNCHRONOUSLY MOVING SEAT AND SEAT BACK

FIELD OF THE INVENTION

The present invention relates generally to the field of seating and in particular to a chair in which the seat and seat back move in concert to provide a reclining position for the user.

BACKGROUND OF THE INVENTION

There is an ever-present need for economical and temporary seating space that is typically satisfied by the provision of low cost stackable chairs. The use of low to moderate cost stacking chairs is well known in the art. However, such chairs are designed not with comfort or ergonomics in mind, but rather to provide a large quantity of temporary seats for occasional use, which can ordinarily be stored and take up minimal storage space.

Recent years have brought a growing interest in the development of such chairs based on ergonomic designs intended to promote a sitting posture with a

maximum of comfort. One aspect of comfort is the ability to adjust the back of the chair to suit the user. Unfortunately, most stacking chairs do not provide any adjustment capabilities and the ones that do merely provide limited flexibility in the seat back portion with little ergonomic benefit. On the other hand, home and office chairs have been produced in a variety of ergonomic designs that have mechanisms for moving the backs of the chairs into a reclining position.

Chairs featuring the ability to adjust for certain preferences of the user relating to seat height, reclining range, and the like are also well known in the art. These features are accompanied by complexity of manufacture and require the use of expensive and complicated mechanisms that are cumbersome or awkward to adjust and may be subject to malfunction. Such chairs are not suitable for stacking nor use for temporary seating.

In the prior art, U.S. Patent No. 5,944,382 to Ambasz features a chair providing movement of both the seat and seat back. The Ambasz chair features a slideable seat and also a moveable seat back. There is a separate lumbar section between the seat bottom and the seat back making a three-part seat assembly. The seat bottom has a pair of sockets that fit over seat supporting portions of the seat frame to allow the seat bottom to slide forward and aft. The seat back slides up

and down and also tilts to the rear to recline. The seat back is mounted on an articulated linkage that includes springs between the seat back and the upper portion of the linkage to bias the seat back in the upward position. Bellows members connect the seat bottom and the lumbar section and the seat back together. The Ambasz design typifies the complexity and expense of most ergonomic chair designs. Moreover, the Ambasz chair does not lend itself to stacking for storage.

One attempt to marry ergonomics with economics is shown in U.S. Patent No. RE36,335 to Perry, which discloses a chair having a flexible frame to achieve partial reclining of the seat back. The seat back interconnects the ends of a continuous chair frame with one end projecting upward from the rear legs to the seat back and the other projecting upward from the rear of the seat to the seat back. This two-point connection to the seat back along with curved frame members through the seat back allows limited pivoting of the seat back and also limits pivoting of the seat back. The chair is stackable but of limited comfort, lacking the natural feel provided in a chair having coordinated movement between the seat and seat back.

A need has remained for a chair combining the benefits ergonomic design in a low cost and stackable chair.

SUMMARY OF THE INVENTION

Briefly describing one aspect of the invention, a chair featuring a movable seat bottom and seat back is provided. The seat bottom and seat back move in concert between an upright position and a reclined position. The chair includes a frame having a seat bottom support portion and a seat back support portion. In one embodiment, the seat bottom support portion includes a pair of side support members on which the seat bottom is slidably supported. The seat back support portion includes a transverse member to which the seat back is pivotably connected. In one aspect of the invention, this pivotable connection can be accomplished by a plurality of hooks that are preferably molded into the seat back.

The seat bottom and seat back are connected to each other in a manner that allows the seat bottom to slide forward and the seat back to recline in response to the natural forward movement of the seated user's pelvis along with pressure on the seat back from the user. With this feature, the pivotable connection of the seat back to the support frame allows the frame to act as a fulcrum. Specifically, as force is applied to an upper portion of the seat back, the back pivots about the

frame, thereby exerting a force on the seat bottom, causing the bottom to slide along the seat bottom support.

In a preferred embodiment, the seat bottom and seat back are most preferably a one-piece molded plastic shell having a resilient intermediate portion interconnecting the seat bottom and seat back. The intermediate portion operates primarily as a deformable and resilient hinge. Secondarily, the resilient intermediate portion can act as a force transmitting element that translates the pivoting movement of the seat back into a fore and aft force on the seat bottom. The natural characteristics of the plastic shell causes it to rebound to the original position without the use of any mechanical devices as the user brings herself back to the non-reclined position or rises out of the chair.

In certain features, the resilient intermediate portion forms a slack region that exhibits a first curvature when the seat is in an original, non-reclined orientation. When the user reclines, the seat back pivots, the seat bottom slides, and the intermediate slack region deforms to a different second curvature. The resilient intermediate region is configured to allow the user to easily recline the seat by leaning back against the pivotable seat back, while the seat back maintains support for the user's back at any angle of recline.

The invention further contemplates the use of rail members and slide blocks to effect sliding of the seat bottom. In one preferred aspect, the upper portions of multiple slide blocks are integral with the underside of the seat bottom. Lower portions of the slide blocks can be combined to form a channel slidably surrounding a corresponding one of the rail members. Stops can be provided at opposite ends of the rail members to limit the fore and aft movement of the seat bottom relative to the seat frame.

In one embodiment of the invention, the chair is provided with legs configured to facilitate stacking, while still retaining the pivoting seat back and sliding seat bottom features. In an alternative embodiment, the chair can be provided with a castered pedestal base for ease of movement. Similarly, the chair can be provided with or without arms. In certain armchair versions, the arms project from the back frame at a slight outward angle and with a slight curvature to provide a comfortable seating experience for the user.

Accordingly, it is one object of the invention to provide an ergonomic chair of relatively simple construction, without mechanical springs or lever devices, and at a reasonable cost. Another object is achieved by features of the invention that

allow a user to easily recline the chair while the seat back maintains support for the user's back.

Another object of the invention is to provide a chair with a one-piece molded shell that can be not only reclined, but also easily stacked when not in use. These and other objects, advantages and features are accomplished according to the devices and assemblies, and methods of the present invention.

DESCRIPTION OF THE FIGURES

FIGURE. 1 is a front perspective view of a chair according to one embodiment of the present invention.

FIGURE 2 is a side perspective view of a chair frame for use with the embodiment of the inventive chair depicted in **FIGURE 1**.

FIGURE 3 is a top elevational view of the chair frame shown in **FIGURE 2**.

FIGURE 4 is a back elevational view of two chairs according to the present invention depicted in a stacked arrangement for storage.

FIGURE 5 is a side elevational view of the chair shown in **FIGURE 1**.

FIGURE 6 is a rear elevational view of the chair shown in **FIGURE 1**.

FIGURE 7 is a side elevational view of a chair according to an alternative embodiment of the present invention.

FIGURE 8 is a rear elevational view of the chair shown in **FIGURE 6**.

FIGURE 9 is a bottom perspective view of a chair, such as the chair depicted in **FIGURE 1**, showing the attachment of the seat bottom to the bottom frame according to one aspect of the invention.

FIGURE 10 is an exploded view of a slide block assembly according to one embodiment of the invention for use in the attachment depicted in **FIGURE 8.**

FIGURE 11 is a front perspective view of an armchair according to one embodiment of the present invention.

FIGURE 12 is a top perspective view of the chair shown in **FIGURE 11.**

FIGURE 13 is a front perspective view of a chair including armrests and a castered pedestal base according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. The invention includes any alterations and further modifications in the illustrated devices and described methods and further applications of the principles of the invention that would normally occur to one skilled in the art to which the invention relates.

The present invention provides a chair with a synchronously moving seat and seat back. The seat slides forward as the seat back tilts rearward to provide a reclined seating position in response to the natural forward movement of the seated user's pelvis along with the user leaning against the seat back. The resilience of the seat allows it to return to an upright seating position when the pressure on the seat back is removed.

Referring to the drawings, a chair **10** in accordance with one embodiment of the invention is illustrated in **FIGURE 1**. The chair **10** includes a seat assembly **11** and a frame **12**. Frame **12,** which is preferably of a metal construction such as steel, is shown in detail in **FIGURES 2-3**. Frame **12** includes a seat bottom support member or portion **20**, and a seat back support member or portion **16**. Seat bottom support **20** includes front and rear transverse members **22A** and **22B** respectively, and a pair of frame rails or side support members **24**. Preferably, side support members **24** are the primary elements supporting the seat bottom **32** when the seat assembly **11** is mounted on the frame **12**. Preferably, the elements of the frame **12** are of tubular construction, most particularly the frame rails or side support members **24**.

Seat back support portion **16** includes a pair of upright support members **17**, and a transverse support element **18** that interconnects the upper ends **19A, 19B** of the upright support members **17**. Transverse support element **18** is preferably positioned at approximately the center of the seat back when the seat assembly **11** is in place on the frame **12**. As shown more clearly in **FIGURE 3**, transverse support element **18** has a center portion **18A** that is displaced rearwardly from the upright support elements **17** in this embodiment. Right and left end sections, **18B**

and **18C** extend at an angle α forward and also slightly upward from center section **18A** to connect to the upright support elements **17** and to maintain contact with shell hook members described herein. End sections **18B** and **18C** also angle forward to accommodate a curvature or concavity of the seat back **34**.

In one embodiment of the invention, as depicted in **FIGURES 2** and **3**, the chair is supported by front legs **13** and rear legs **15**. Preferably, front legs **13** project slightly forward and outwardly from seat bottom support portion **20**, while rear legs **15** project slightly outward and rearwardly from seat back support portion **16**. In this particular embodiment, each rear leg **15** is connected to the corresponding front leg **13** with a ground-engaging component or floor member **14** in a sled configuration. In this embodiment, each floor member **14** is integral with the corresponding rear member **15** and is welded at a weld point **14A** to the corresponding front leg **13**.

These features provide stability to the chair while in use and also allow the chair to be stacked when not in use. In one embodiment, the configuration of the legs **13** and **15** allows the chair **10** to be stacked with other similar chairs to facilitate storage, as depicted in **FIGURE 4**. In this embodiment, the seat assembly **11**, and particularly the seat bottom **32** has a width, and the legs **13** and

15 are flared outwardly to a width greater than the width of the seat bottom to allow the chairs to be stacked.

For certain features of the invention, the configurations of the legs **12, 13** and floor member **14** are not critical and any suitable design is contemplated. Other suitable configurations include, but are not limited to, four-leg, cantilever and caster-based styles.

Returning now to **FIGURE 1**, seat assembly **11** includes a seat bottom **32** and a seat back **34**. In accordance with beneficial features of the invention, seat bottom **32** is slidably engaged to frame rails **24**, while seat back **34** is pivotably supported by the transverse support element **18**. Most preferably, the seat back **34** is supported at the center section **18A** of transverse support element **18** with a plurality of connectors. The seat back **34** is positioned relative to the transverse support element **18** so that an upper portion **34A** of the seat back is situated above the support element. In this way, the user can apply pressure or force against the upper portion **34A** to recline the chair **10**, with the support element **18** acting as a fulcrum.

FIGURE 3 shows a preferred angular configuration of transverse support member **18**. This geometry accommodates a concave curvature in the seat back

34, which provides comfort for the user throughout the entire range of movement of the chair. In particular, the center section **18A** is supported by left and right sections **18B** and **18C**. **FIGURES 3, 5 and 6** show the upward projection of the right and left sections **18B** and **18C** of transverse support element **18**.

In a preferred embodiment, the seat back **34** is pivotably supported on the support element **18** by way of a number of connectors **42** that engage the support element. In a preferred embodiment, these connectors are hooks **42A** and **42B** attached to the seat back **34** as shown in **FIGURES 5 and 6**. Most preferably, hooks **42A** and **42B** also are formed with stiffening ribs **42C** to add stiffness to seat back **34**. Stiffening ribs **42C** also blend hooks **42A** and **42B** into seat back **34** for a more aesthetic effect to the rear side of seat back **34**.

Center section **18A** of transverse support element **18** is a pivot axis or fulcrum about which seat back **34** can pivot or rotate to and from a reclined seating position. The hooks or connectors **42** attaching seat back **34** to the transverse support element **18** are preferably of two types. Referring to **FIGURE 6**, hooks **42A** engage the center section **18A** with a snap-fit to limit the motion of seat back **34** to that of rotation relative to this section of transverse support element **18**. The snap-fit hooks **42A** thus help retain the seat back **32**, and ultimately the entire seat

assembly **11**, engaged to the chair frame **12**. The second type of hooks, hooks **42B** supported on the angled portions **18B** and **18C** of the transverse support element **18** preferably do not clamp or snap-fit to the transverse support element **18**. Most preferably, hooks **42B** are provided with clearance to move relative to transverse support element **18** as seat back **34** rotates.

In accordance with certain features of the present invention, any suitable connector **42** is contemplated so long as the transverse element **18** is freely rotatable to ensure smooth movement of the chair. For instance, in an alternative embodiment, hooks **42A** could be replaced by mounting pad **40** mounted on seat back **34'**, as depicted in **FIGURES 7 and 8**. The mounting pad **40** defines a recess **37** configured for snap-fits onto center section **18A**. Mounting pad **40** is preferably integral with seat back **34'** and can be used either alone or in combination with hooks **42B** on sections **18B** and **18C** of transverse support element **18**.

Referring again to **FIGURES 5 and 6**, seat back **34** can include a lip **35** that wraps around the upper ends **19A**, **19B** of upright support members **17** to prevent any lateral movement of the seat back relative to the frame. In addition, the peripheral lip **35** adds stiffness to the seat back **34**, particularly when the seat assembly **11** is in the form of a molded shell.

Seat assembly **14** preferably includes a resilient intermediate portion **46** which provides hinge movement, as shown most clearly in **FIGURES 1, 5 and 7.** Intermediate portion **46** interconnects seat bottom **32** and seat back **34** and links relative movement between seat bottom **32** and seat back **34**. In a preferred embodiment, intermediate portion **46** includes an upper region **47** connected to the bottom portion **34B** of seat back **34**, and a slack region **48** connected to seat bottom **32**. Upper region **47** preferably exhibits a curvature that provides lumbar support to the user in both reclined and upright seating positions. Slack region **48**, also referred to as a rebound section, exhibits a slight rearwardly curved projection that provides slack in the seat material. This slack is taken up as the seat bottom **32** slides forward on the rails **24**, without being lifted from the seat frame **20**. Referring specifically to **FIGURE 5**, the intermediate portion **46** is resiliently deformable and exhibits a first curvature in an original position of the slack region **48**. As the seat is reclined, the intermediate portion deforms to a different second curvature, as the slack portion is slightly flattened out.

As shown most clearly in **FIGURE 6**, intermediate portion **46** preferably has a nominal width W_2 that is less than the width W_1 of seat back **34**. This reduced width is most advantageous when the seat back **34** has a concave curvature

to provide adequate clearance for a person sitting in the chair. Of course, the relationship between the two widths is not critical, and W_2 may equal or exceed W_1.

Preferably, seat assembly **14** will be composed of a resilient material at intermediate portion **46**. Most preferably, seat assembly **14** is a one-piece shell made from a resilient material, such as polypropylene or other similar materials. However, it is important that the intermediate portion be able to withstand repeated flexing or deformation as the seat is reclined and then returned to its upright position. Most preferably, the intermediate portion **46** is not only resilient, but also sufficiently stiff to transmit force, generated by the pivoting movement of the seat back **34** to the seat bottom **32**. This transmitted force can assist the sliding movement of the seat bottom along the frame **12** and assist the return of the seat bottom to its original non-reclined position.

Seat assembly **11** preferably includes at least one slide block **38** connecting seat bottom **32** to frame rails **24**, as shown in **FIGURES 5, 9 and 10**. One version of slide block **38** is shown in detail in **FIGURE 10**. Slide block **38** has an upper portion **52** connected to a lower surface **32A** of seat bottom **32** (**FIGURE 9**) and a lower portion **54**. Suitable fasteners such as screws **57** connect these two portions

52, 54 via threaded holes. In this particular embodiment, lower portion **54** can define a pair of through-holes **54A** for inserting screws **57** to engage corresponding holes (not shown) in upper portion **52**. The corresponding holes can be, for example, threaded or self-threading.

Each portion **52, 54** of the slide block **38** defines a channel **58** or upper and lower portions of a bore configured to receive a frame rail member **24**. In a preferred embodiment, each half of the slide block **52, 54** also includes a self-lubricating bushing **56** inserted into channels **58**. The shape of bushings **56** correspond to that of channels **58**. Bushings **56** provide bearing surfaces **60** to reduce friction as the seat bottom **32** slides along the side support members **24**. In one particular embodiment, tabs **55** projecting from bushings **56** are receivable in corresponding slots **59** in the slide block upper and lower portions **52, 54** to lock the bushings **56** in position. Tabs **55** are preferably positioned to form an angle of less than about 90°, with a most preferred angle of about 45°. Bushings **56** are preferably made of a material such as polyamide resin, which is preferably harder than the material of the chair seat assembly **11** or the slide block **38** bodies.

In a preferred embodiment, the upper portion **52** of the slide block **38** can be made integral with the lower surface **32A** of seat bottom **32**. In this embodiment,

the side support members or rail members **24** are parallel to each other and extend forward and aft in the direction of motion of seat bottom **32**. Also, in a preferred embodiment of the invention, two such slide blocks are used on each side support member. It is contemplated that a suitable number of slide blocks will be used as required for the smooth operation and stability of the chair.

Referring now to **FIGURES 2 and 9**, each side support member or rail **24** preferably includes a pair of stops **26A, 26B** for limiting the travel of the seat assembly **11**. Front stops **26A** limit forward travel, while rear stops **26B** limit rearward movement and help define the original non-reclined position of the seat bottom **32**. In this particular embodiment, front stops **26A** are provided on a bottom surface of the frame rails **24**, away from the underside of the seat bottom. On the other hand, back stops **26B** project from the top surface of the rails **24**, adjacent or facing the underside of the seat bottom. It has been determined through testing that the chairs of this invention, with the stops configured in this manner, can have a greater resistance to damage from impact when the chair is dropped. However, stops can be provided on any suitable surface of the frame rails **24**. Alternatively, front and rear transverse members **22A** and **22B** can perform this limiting function.

Referring again to **FIGURE 9**, seat bottom **32** also preferably includes reinforcement or stiffening ribs **39**. Ribs **39** can be molded into seat bottom **32** to add strength to the front portion of seat bottom **32**, particularly when the seat is reclined. In the preferred embodiment, the seat bottom is configured so that a portion is cantilevered over the support frame **12**. The ribs **32** project into this cantilevered portion, adding stiffness and allowing the amount of front overhang of seat bottom **32** relative to front transverse member **22A** to be increased. Moreover, the ribs **32** extend inboard of the seat bottom for sliding support on the frame **12**, and most particularly the front transverse member **22A**.

Numerous variations of the invention are contemplated. For instance, the frame rail or side support members **24** can be non-parallel, in which case a channel would be provided in the seat bottom to allow for lateral movement of the slide blocks in response to the divergence of the side support members. Alternatively, the slide block could be modified to include a slot wide enough to accommodate the divergence of the side support members.

In another version of the invention, the side support members could comprise a slotted structure configured to receive a pin attached to the underside of the seat bottom. The slots in the side support members can then act as a channel

within which the pin travels as the seat slides back and forth. The length of the channels could determine the extent of motion provided to the seat bottom. Here again, if the side members are not parallel to each other, the seat bottom could include a transverse slot for each pin to allow lateral movement of the pin relative to the seat bottom to accommodate the lateral motion introduced by the non-parallel side support members.

Referring again to **FIGURE 5**, in use, the seat back **34** reclines as the seat bottom **32** extends in response to a user leaning back against seat back **34** and the natural forward movement of the user's pelvis. The extension of seat bottom **32** and the rotation of seat back **34** causes deformation of the intermediate portion **46** from its original configuration, thereby placing this portion in tension. This tension in intermediate portion **46** causes the seat to return to its upright position when unoccupied or when the user of the chair removes pressure from the seat back **34**. The resilience of the seat **11** causes it to rebound to the original position without the use of any mechanical devices.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. It should be understood that only the preferred

embodiments have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected. For example, arms **64** can be provided to produce an armchair as in **FIGURES 11** and **12**. As shown in **FIGURE 12**, arms **64** preferably flare slightly outward and exhibit a slight inward curvature to provide a more natural and more comfortable seating position. In addition, these features more comfortably accommodate the larger user and allow for the free movement from side to side. In yet another version of the invention, the seat bottom frame can be mounted on a pedestal base **66** as in **FIGURE 13**, which includes castors **68** for ease in moving the chair.

This invention presents an aesthetically pleasing ergonomic chair of simplified design. The simplified design allows the chair to be produced at a reasonable cost. The stackable feature allows the chair to be stored within a minimum of space when not in use. It should be noted however, that the user does not have to change his position relative to the seat bottom of the chair in order to move the chair from an upright to a recline position. The user need only relax and lean back against the seat back. Thus the seating position can be changed without undue ruffling and disturbance of clothing. This provides a further benefit in

embodiments in which the chair is upholstered because the movement of the user in the chair does not cause wear on the upholstery. One of the most important features of this invention is that the chair remains comfortable to the user even after long periods of time due to its ability to respond when the user changes seating position. The user merely sits back, and the chair knows what to do.